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Bill Pennington, Project Manager
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California Energy Commission
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Dear Mr. Pennington:

Thank you for the opportunity to comment on the Energy Commission's 2005 draft proposed amendments to Title 24, Part 6. Our comments concern the proposed revisions to Section 121, concerning demand control ventilation (DCV).

On November 18, 2005, Energy Commission staff provided the Division with a copy of revised proposed regulations regarding minimum ventilation rates. For the reasons listed below, we would suggest that the Energy Commission consider postponing its plans to adopt the current proposal to extend DCV to additional occupancies and to change DCV operating parameters.

Alternatively, we would suggest that the mandatory language be changed to permissive language which would allow the Department of the State Architect to approve a limited number of pilot DCV installations in renovation projects in schools. We would also suggest that the Energy Commission consider funding a Public Interest Energy Research study on those pilot projects so that data would be available for the next round of revisions to Title 24. This research should involve all of the stakeholders in the school environments. This would allow greater confidence in concluding that our moves towards energy efficiency are not compromising air quality in schools and other occupancies.

The following summarizes the Division's specific concerns with this proposal:

1. There is insufficient research regarding the use of DCV systems in classrooms. Schools, and particularly K-12 schools, are sensitive environments and pose unique challenges to maintaining adequate air quality. In response to the Division's request for information regarding field studies in schools, the Commission furnished an article, "State of the Art Review of CO2 Demand Controlled Ventilation Technology and Application" (NISTIR 6729). This article contained reports of only three DCV systems installed in schools, none of which were designed as described in the Commission's draft proposal. A study sponsored by the Energy Commission regarding DCV systems has not been completed. The lack of sufficient data on the effects of DCV systems in schools raises concerns about making their use mandatory in this context.

2. Carbon dioxide DCV systems require more maintenance checks to ensure performance than conventional systems. There is insufficient information regarding the long-term reliability of carbon dioxide sensors and their integration into control systems. The proposal specifies that the carbon dioxide sensor be warranted by the manufacturer to perform as specified for a period of five years, which is only a small fraction of the projected life of a school or commercial building. Language was deleted from the October 22 proposal that would have required the system to be able to detect sensor failure and default to the standard airflow requirements. The deletion of this failure mode requirement may result in poor ventilation of classrooms and other occupancies for undetermined periods of time. For example, preliminary results from the New Buildings Institute study in 2001 revealed that there were problems with 70 percent of economizers, and that seven percent of the ventilation systems studied were providing no outdoor air (Jacobs). The findings regarding economizers are of particular concern as the DCV systems that are the focus of the Energy Commission's rulemaking proposal would be required to be operated with an economizer. Without a fully operational economizer, these DCV systems will not be able to function properly.

3. In the Division's experience, K-12 schools are particularly vulnerable to ventilation-related maintenance problems. Schools rarely have personnel on-site who are trained in the assessment, repair, and maintenance of the ventilation system. Budget constraints often cause school districts to defer preventive maintenance, and prevent them from replacing malfunctioning equipment. DCV systems will pose additional burdens to school districts in that they will need to purchase and maintain equipment that will enable them to detect failures in the carbon dioxide sensor and other control technology, and to ensure that trained personnel are available to perform maintenance checks on the systems.

4. It appears that the Energy Commission has selected occupant-generated carbon dioxide as an indicator of the need for ventilation because the build-up of carbon dioxide is a reasonably good indicator of the build-up of bioeffluents. However, there are other forms of indoor air pollution that are of concern and are not necessarily related to the build-up of carbon dioxide (Emmerich). For example, studies have shown that classroom activities increase the level of airborne particulate matter, which is associated with increased respiratory symptoms (Kinshella). Classroom activities may also release chemical contaminants, such as solvent vapors from paints. Other sources of contaminants include building components off-gassing, and activities such as construction or remodeling, food service, and maintenance.

5. Occupant-generated carbon dioxide may not be a sufficiently responsive indicator of occupancy, because there is a significant lag time between increases in building occupancy and carbon dioxide build-up in the air. As shown by the mass-balance relationship reflected in the equation on page 22 of the April 23, 2002 Workshop, there is a direct relationship between the ventilation rate, the number of building occupants, and the difference in carbon dioxide concentration between indoor air and outdoor air. Depending on mixing, it can take a significant period of time for carbon dioxide levels to reach the equilibrium levels reflected in this equation (Nabinger). For example, assuming perfect mixing, it would take approximately one hour for a carbon dioxide sensor set at 1100 parts per million (ppm) to detect the presence of 30 people in a previously empty, one thousand square foot classroom. Until that time, the classroom would be receiving

approximately one-third of the outdoor air currently required (at 15 cubic feet per minute per person). This is less than one room air-change per hour. One study of classroom ventilation found mixing factors ranging from 0.15 to 0.74 (Scheff). If these mixing factors are assumed to be correct, the delay in detection of carbon dioxide build up would be significantly greater than the one hour estimated above.

6. The proposal would increase the carbon dioxide set-point of the sensor from 800 ppm carbon dioxide to 1100 ppm, or 700 ppm above the outside air concentration. The rationale provided for this change is that the American Society for Heating Refrigeration and Air Conditioning Engineers (ASHRAE) has found that 80 percent of visitors find odor conditions acceptable as long as the ventilation system provides sufficient outside air to maintain carbon dioxide levels within 700 ppm of outside air. This apparently reflects a conclusion that the sentiments of 20 percent of the visitors can be ignored. However, bioeffluent odors are not the only determinant of acceptable indoor air quality. For example, Apte et al found a dose-related increased risk of indoor air quality related symptoms as carbon dioxide build-up increased. Statistically significant effects were found when indoor carbon dioxide concentrations were 250 ppm higher than the outdoor concentration of carbon dioxide. This is consistent with a number of studies that find increased comfort and health complaints in buildings where carbon dioxide concentrations are above 800-1000 ppm (Seppanen). It is also consistent with studies finding increased use of sick leave and decreased performance related to ventilation rates below 20 cfm per person of outside air, and additional benefits when outdoor air ventilation rates are increased to 50 cfm. (Wargocki, Milton).

We hope you find the comments given above useful. The Division of Occupational Safety and Health, as the agency that is the primary responder to employee complaints regarding indoor air quality, has encountered such complaints quite commonly. Our experience is that, when situations involving poor indoor air quality arise, they can be difficult and costly to resolve in a manner that is satisfactory to all of those concerned. For this reason, we believe it is important to study very carefully any proposal that could create more air quality problems than we are currently encountering.

Thank you again for your consideration. If you have any questions regarding the above, please contact Senior Industrial Hygienists Deborah Gold at (415) 703-5115 or Robert Nakamura at (415) 703-5160.

Sincerely,

Len Welsh
Special Counsel

DG/dg
cc: Suzanne P. Marria
Steve C. Smith
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Deborah Gold

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